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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

WASHINGTON

Technical News Bulletin No. 82.

February 9, 1924.

GENERAL NOTE

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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1 A New Electric Telemeter

As the result of several years work, the Bureau of Standards has developed a new electric telemeter by means of which measurements may be made of strains, forces, displacements, and accelerations, and the results indicated or recorded at some remote point.

This new instrument depends for its operation upon the pressure-resistance characteristic or the corresponding displacement-resistance characteristic of a stack of carbon plates. Difficulties, such as erratic behavior, hysteresis effects, and lack of linear relationship between resistance and displacement have been overcome, so that the instrument has proved satisfactory where earlier devices have failed.

Thus far the telemeter has been used for the following purposes:

(1) Measurement of loads in airplane stay cables during flight.
(2) Measurement of strains in airship girders and bridge members during construction tests.
(3) Tests of bridge members subjected to live loading.
(4) Tests of airship girders and bridge members in the laboratory.
(5) Measurement of pull on dynamometer arm.
(6) Measurement of pressures ranging from a few millimeters of mercury to 40,000 lbs. per square inch.

The use of one of these instruments results not only in a great saving of time and effort where a large number of readings are needed, but also enables several classes of measurements to be made, not hitherto obtainable in their true proportions.

2 Non-Destructive Test of Wire Rope

An investigation of the possibility of developing a non-destructive test for wire rope in hoisting service has been under way at the Bureau of Standards since July, 1923. This investigation was mentioned in paragraph 10 of Technical News Bulletin 75.

At a meeting of the Advisory Committee for this investigation, it was decided that methods involving magnetic testing should be given first consideration. It has been found necessary to obtain certain fundamental information not heretofore available before proceeding with the design of field apparatus. It was necessary first to consider the effect of stress on magnetic properties, since a hoisting rope in place is always under stress of varying magnitudes, according to the position of the load.

A method of analysis has been discovered which appears to be capable of indicating the relative proportions of the material which are under tension and under compression. This work has also demonstrated, apparently, that the difficulty heretofore experienced in attempting to find the laws of corelation between magnetic and other physical properties can be attributed to the effect of stress, as the magnetic properties are very sensitive to this influence.

Preliminary work has also been done on the effects on the magnetic properties of various factors causing deterioration of the steel wire from which the rope is made.

A progress report covering this investigation has been prepared and submitted to members of the Advisory Committee.

3 Directive Type of Radio and Its Application to Navigation

The Bureau of Standards in cooperation with the Signal Corps and the Air Service of the Army is developing an improved type of radio beacon, which it is believed will do much to increase the safety of navigation both on the water and in the air.

Briefly the device consists of an ordinary form of radio transmitting set located at a light house or other suitable point and connected to a pair of coil antennas. Each antenna consists of a single turn of wire in the form of a vertical rectangle about 100 ft. long by 50 ft. wide. These two rectangular antennas cross each other at an angle of 135 degrees. Signals are transmitted alternately from each of these coils and since this type of antenna transmits a maximum signal in one direction and practically no signal at right angles, a receiving set located along the line bisecting the angles formed by the two crossed coil antennas will receive signals of equal intensity from each of the coils.

A ship or airplane provided with an ordinary receiving set may thus be guided along this bisecting line toward or away from the radio beacon. Should the vessel deviate either way from this course, the two alternate signals will become noticeably unequal in intensity. The proper course may thus be followed regardless of visibility conditions and without dependence on land marks or the magnetic compass.

This new aid to navigation is described in Scientific Paper, No. 480, "A Directive Type of Radio Beacon and Its Application to Navigation," which may be obtained from the Superintendent of Documents at 5 cents a copy.

4 Tests of Radio Receiving Sets (IV)

The results of an investigation of the characteristics of radio receiving sets made by the Bureau of Standards in 1921 and 1922 are given in a series of letter circulars. The fourth and last of the series is Letter Circular No. 109 which has just been issued. This describes the results of tests of seven electron-tube receiving sets, some of them of a frequency range from about 30 to 300 kilocycles (10,000 to 1,000 meters) and others from about 80 to 1700 kilocycles (3750 to 175 meters). The third of the series, Letter Circular 102, described the results of tests on a number of short-wave regenerative receiving sets; the second, Letter Circular 93, gave the results of tests on a number of receiving sets which utilize crystal detectors, and the first, Letter Circular 90, gave the results of tests on a number of electron-tube receiving sets for continuous-wave reception. Copies of letter circulars 90 and 93 are no longer available. It is believed that the methods followed and the examples given in these reports will be of assistance to manufacturers in the development of methods for testing, describing, and improving their products. The particular receiving sets are referred to by arbitrary reference numbers rather than by a statement of the manufacturers' names and type numbers.

Letter Circular 109 is available only in mimeographed form, but a limited number of copies are available for distribution to testing laboratories, manufacturers, and others who can show that they are directly concerned with the testing of receiving sets. Requests should be addressed to the Bureau of Standards, Washington, D. C.

5 Effect of Variations in Vulcanization on the Electrical Properties of Cable Insulation

During the past month the Rubber Section of the Bureau has carried out some work on the effect of variations in vulcanization on the electrical properties of rubber insulating materials for cables. A number specimens of the compound: smoked sheets, 92 percent and sulphur 8 percent were prepared for the purpose of determining the effect on the electrical properties of conducting vulcanizing at different temperatures and for different lengths of time. The results indicate that for a given state of cure the electrical properties are practically independent of the means by which that cure was effected, whether by vulcanizing for a long time at a low temperature or a shorter time at a high temperature.

6 Redetermination of Secondary Standards of Wave Lengths of Light From the New International Iron Arc

The system of secondary standards of wave length now in common use was derived from an axial part about 2 mm wide in the center of an iron arc about 6 mm long, and was established before the full importance of operating conditions of sources was recognized. In this type of arc, certain lines, grouped as c and d lines because of their sensitiveness to pressure, appeared to be displaced with respect to others grouped as a and b lines,

so that the International Astronomical Union in 1922 recommended that the length of the arc be 12 to 15 mm and that light be taken from a central zone not to exceed 1-1.5 mm in width. These changes in the standard iron arc made it desirable to redetermine the secondary standards of wave length. Work of this kind was therefore undertaken by the Bureau of Standards, and is described in Scientific Paper, No. 478, which may be obtained from the Superintendent of Documents at 5 cents a copy. The well-known interferometer method of Fabry and Perot was employed to measure wave lengths of selected lines in the iron spectrum directly in terms of the primary standard, the wave length of the red radiation from cadmium which served for the wave-length-meter comparisons. New results are given for 159 lines between 3370 A and 6678 A, including 84 of the international secondary standards. For 23 lines belonging to groups c and d, the secondary standards minus the new values averages +0.0072 A. There is also a systematic difference for lines of groups a and b, 44 such lines averaging 0.0029 A less than the present international values. The reason for the latter divergence is not obvious, but it may be due to a real error in the international system which, it is pointed out, was not established strictly according to the logical definitions of such a system nor with the accuracy which might be possible now in a redetermination.

7 Interferometer Measurements of the Longer Waves in the Iron Arc Spectrum

Scientific Paper No. 479 of the Bureau of Standards, which may be obtained from the Superintendent of Documents at 5 cents a copy, describes interferometer measurements recently completed of the longer waves in the iron arc spectrum.

The international system of secondary standards established by interferometer comparisons of the wave lengths of selected lines in the iron arc spectrum with the wave length of the primary standard, the red radiation from cadmium, extends, at present, from the ultra-violet to the red, but no extensive comparisons of these spectra existed for iron waves longer than 6750 A. Using the international iron arc as a source of secondary standards and cadmium vapor lamps similar to those used in the wave-length meter comparisons for the primary standard, new values have been obtained for 161 lines ranging in wave length from 5534.525 to 8824.238 A. Seventy-five of these are longer than 6750 A. The probable error of each value is of the order of 0.001 A. In the region in which these determinations overlap the international standards there is a systematic deviation indicating that the accepted international scale is nearly one part in a million too large. Comparison of these values with the relative ones obtained in the same spectral interval by Burns shows good agreement if the latter are adjusted to the new scale of absolute values. A figure illustrating the dispersion of phase change at reflection in interferometer mirrors of silver and copper is given.

8 The Effect of Moisture on the Sensitiveness of Photographic Emulsion

It has been frequently stated that the sensitiveness of a photographic plate is affected by the humidity or moisture content of the emulsion. It is well known that a plate which has been dipped in water is less sensitive while wet than in the dry condition but there appears to be no data on the sensitiveness of the plate under various degrees of humidity between the wet and ordinary dry states. In order to determine the effects of the moisture content upon the sensitiveness it is first necessary to know how long to keep the plate in a chamber in which the humidity is maintained at a definite value before equilibrium is reached. The Bureau of Standards has been carrying out some work on this problem and a preliminary trial indicates that the emulsion will absorb or give off moisture at a very rapid rate. For example, a plate first conditioned in an atmosphere containing one percent saturation will, upon being placed in another chamber having fifty percent humidity, reach equilibrium in one hour. In the first five minutes it will reach a point of about one-half equilibrium. This work will be continued.

9 Absorption of Nitrogen by Diffusion Through Glycerine

Mention was made sometime ago (Bulletin No. 75, Item 26) of the difficulty which the Bureau has experienced in securing a suitable liquid seal for gas-holders containing very pure hydrogen.

Various liquids have been tried and thus far crude glycerine has proved the most successful. Analyses made of some hydrogen which had been stored in a gas holder over crude glycerine showed that the rate of absorption of nitrogen by diffusion through the glycerine had been at a rate equal to about 1/10 the rate of absorption through machine oil.

This is a great improvement, but is not quite as good as was expected. It is thought that evolution of nitrogen contained in the glycerine may have occurred when it was first placed in the holder, and to check this another analysis will be made later to determine whether the rate of absorption has diminished.

10 Exposure Tests on Colorless Waterproofing Materials

The investigation which the Bureau has been conducting during the past three years on colorless waterproofing materials for building stone is described in Technologic Paper No. 248, which may be obtained from the Superintendent of Documents at 5 cents a copy.

The object of this work was to determine the relative effectiveness and durability of several colorless waterproofing materials, both of a proprietary and nonproprietary nature. The treatments were applied to specimens of sandstone and limestone, which were afterwards exposed to the weather for long periods. The specimens were subjected to an absorption test about once a month, and in this way the effectiveness of the various treatments was determined. The paper contains curves which present in graphical form the data thus secured. Information is also given concerning the effect of the treatments on the

appearance of the stone. Many of these treatments produced some discoloration when first applied, but after weathering for a few months the appearance of the treated stone was generally better than that of the untreated specimens.

Most of the treatments investigated fall into one of five classes according to composition. Two entirely different treatments are also described, one consisting of paraffin, and the other of a solution of cellulose nitrate in a solvent-like fusel oil.

The treatments giving the highest waterproofing values and showing very little deterioration during the two years of exposure were those which employed paraffin alone or in conjunction with China wood oil as the waterproofing medium. The treatment which gave the highest waterproofing value on all textures was one consisting of paraffin applied in the molten condition.

For more extended progress reports on this work the Bulletin for the past three years should be consulted, beginning with Item 13 in Bulletin No. 44, December 9, 1920.

11 Tests of "Nel-Stone" Walls

At the request of the Commissioners of the District of Columbia the Bureau has carried out some tests to determine the compressive strength of walls constructed of "Nel-Stone" building units and to determine the suitability of this system of construction for wall purposes. The "Nel-Stone" system makes use of specially constructed precast mortar blocks 12 inches square which are laid up without mortar joints or beds. The units are so shaped that when set in place in a wall there are interconnecting, horizontal and vertical passages of circular cross-section throughout the wall. In these passages the reinforcement is placed and they are then filled with cement mortar of one to three proportion. Tests were made on nine walls, 6 feet long by 9 feet high with thicknesses of 4, 6 and 8 inches. Three experiments were made for each thickness. The average strength of the walls at failure was 700 pounds per square inch. From the results of these tests it would appear that walls built with "Nel-Stone" units and in a manner similar to that used in constructing the test specimens compare favorably with common brick walls. Where the load carried by the wall is axial and no bending is introduced, any of the walls tested would be safe for a unit working load of 250 lb. per square inch.

12 Physical Properties of Clay Bodies as Affected by the Drying Treatment

During the past month five experiments were performed in connection with a study of the rate of moisture diffusion through clay and the removal of moisture from the surface. Variations introduced in these experiments have included size and shape of the bodies being dried, temperature, humidity and velocity of air movement and types of clay. One experiment has been performed to show the rate of temperature rise within a clay body during drying. The vapor tension of the moisture in

the clay depends upon this temperature. The temperature of a clay body undergoes a gradual rise from the wet bulb temperature of the surrounding air when the clay is extremely wet to the dry bulb temperature of the air when dried. Incidental to general drying tests on three different clays the modulus of rupture has been determined for pieces having from 12% residual moisture to zero moisture at 110° C and about 4% relative humidity. The increase in strength with reduced moisture content varies in different clays but in all cases the removal of the last 1 percent increases the dry strength from 50 to 100 percent and in some cases more. It seems probable that inconsistencies in the dry strength of pieces which can not be attributed to structural defects arise from slight variations in the moisture content. A survey of typical clays of the country as regards their drying properties is in progress. Two tests on clays received here have been carried out during the month. These include a second test on a Texas surface clay and one on an Iowa shale. Numerous additional offers of cooperation in this work have been received from manufacturers and manufacturers' associations. Selections are being made from these according to locality and the types of clay offered.

13 The Abrasive Hardness of Ceramic Glazes

A brief description was given a short time ago in the Bulletin of the apparatus which the Bureau is using to determine the resistance of ceramic glazes to abrasion. Studies have recently been made of the loss in weight, during test, of the same specimen in successive intervals of time. The loss in weight is at first slow but after the polished surface is worn away the rate of loss becomes constant for a single glaze although it varies for different glazes. The question arises as to how long a test must be run in order to get weight losses proportional to glaze serviceability. Since it seemed desirable to answer this question without an actual service test a method was tried in which two plates of the same brand were held in the hands and shuffled one over the other until there was a noticeable abrasion. Seven brands treated in this way 2000 times for each pair were classified through visual observation by different observers in approximately the same order as the figures obtained with the testing apparatus.

14 Wet-Process Enamels for Cast Iron

Wet-process enameling of cast iron is becoming important because of its application to the enameling of stove parts, sanitary fittings and hardware. Technologic Paper No. 246 which may be obtained from the Superintendent of Documents for 10 cents a copy, is a report of an extended investigation which the Bureau has carried out of wet-process enamels for cast iron, both with and without the use of a ground coat. Compositions used in dry process enameling have served as a basis for the work. The effect of varying methods for preparation of frits, mill additions and relation of composition of the enamel to such properties as adherence, texture and opacity have been carefully studied. The paper describes the various ground coats, cover enamels, single coat, and colored and white enamels which were tried out during the experiments and the compositions which gave the most satisfactory results are indicated.

15 Variations in Impact Test of Glass Containers

A study of possible variations in the impact test as a means of showing the relative strength of glass containers has been started. This work indicates that the material from which the impact hammer (which is used for breaking the specimens) is made has an important effect on the results, the softer metals producing a type of fracture quite different from the harder metals such as case hardened steel which it is thought will be satisfactory for this purpose. A study is now under way of the method of supporting the test piece which probably also influences the results.

16 New Type of Tester for Determining Bursting Strength of Paper

A new type of tester for determining the bursting strength of paper has been received by the Bureau and a comparison is being made between this device and the ordinary type in commercial use. In connection with machines of this kind, which employ a pressure gauge to indicate the results, a study is under way of the effect of the weight of the needle on the indications.

17 Tests of Paper Towels

Various methods of testing folded paper towels have been investigated. Fourteen samples representing the products of nine different manufacturers were used. An attempt was made to develop a method of determining the tensile strength when wet, as it was believed that such a test would approximate service conditions. However, satisfactory results could not be obtained because of the weakness and poor formation of most of the samples. Apparently the bursting strength of the dry paper is the most satisfactory indication of its strength. Its absorbency is satisfactorily determined by applying one drop (0.2 cc) of water to the surface and noting the time for complete absorption. The various samples differed considerably in strength and absorbency.

18 Paper for Outlook Aperture of Window Envelopes

The Bureau is conducting a study of the papers used for the outlook aperture of window envelopes, from the point of view of properties and methods of testing.

The transparency and glaze of these papers are of great importance since both low transparency and high glaze are objectionable. In fact mail clerks handling large numbers of window envelopes have complained of the eye strain produced by certain types.

An attempt is being made to find the most suitable paper for this purpose and to develop test methods which will insure securing this kind of paper in the future.

19 Size of Paper Making Fibers

The Bureau is making a compilation of data relating to the size of plant fibers suitable for the manufacture of paper. There is a great deal of information of this nature to be found scattered through the literature, and it is believed that if gathered together in convenient form it will be of considerable value to those carrying out fiber investigations.

20 The Cold Working of Metals

During the past month questions in connection with the effect of temperature of rolling upon the hardness changes induced by cold deformation of metals have received considerable attention. Zinc was rolled at a temperature -15 degrees Centigrade. The specimens were kept in a freezing mixture of salt and ice except while being passed quickly through the rolls at a temperature of from zero to -2 degrees Centigrade. The low temperature did not affect the general form of the scratch and Brinell hardness curves but the material itself became more brittle with initial deformation than has usually been found to be true. Work in connection with the determination of the density changes of copper after cold rolling is being continued. This procedure is rather slow, however, since the material must be given a series of cold rollings after each density determination.

21 Mechanical Properties of Metals at Elevated Temperatures

The Bureau of Standards is constructing an apparatus for "long-time" tension tests to supplement equipment already available for studying the high temperature properties of metals. This new equipment will be used primarily to determine the limiting loads which can be used at different temperatures with the several types of materials already tested by ordinary methods of tension and compression. At the request of the Joint Committee on Phosphorus and Sulphur in Steels, arrangements are under way to make short time tension tests at temperatures of from 20 to 1200 degrees Centigrade, on four of the steels used by the Committee which contain varying proportions of sulphur. At the request of the special committee of the American Society for Testing Materials work has been started on the preparation of a report entitled "Available data on the (Mechanical) Properties of Irons and Steels at Various Temperatures." This will form part of a topical discussion of the properties and applications of metals for high and low temperature service which will be held at the spring meeting of the American Society of Mechanical Engineers in Cleveland, Ohio, under the auspices of that Society and the American Society for Testing Materials.

22 The Wear Testing of Metal

Some of the work which the Bureau of Standards has conducted on the determination of the wear of metals was described some time ago in the Bulletin. At that time it was pointed out that a considerable difference in the rate of wear resulted when the abraded particles were removed from the test specimen and when these were allowed to accumulate. The device designed for cleaning the specimens during a run has been tried out and proved quite successful. The previous results as to the difference between rate of wear when the particles are removed and when they are not were corroborated. When these particles are removed the amount of wear is so small in some cases - 2 or 3 milligrams per hour, that it will be necessary to make runs of several hours duration in order to get comparative quantitative data.

23 Dictionary of Specifications

Progress is being made in the preparation of the Dictionary of Specifications and about two-thirds of all the specifications received have been classified and index cards completed. Some very interesting data have been obtained from state purchasing agents concerning the amounts of money involved in the purchase of various classes of commodities. From the data already on hand it seems safe to state that 50 percent of the money actually expended for commodities by the Federal and State Governments and public institutions is used in the purchase of food for human consumption and of feed and forage for animals. At the same time it is worth while noting that the portion of the classified index relating to food and kindred products contains less than ten percent of the estimated number of cards in the index as a whole. For the above reasons it has seemed desirable to keep the cards relating to foods and similar products separate from the other cards in the index, a plan which has been followed without difficulty because relatively few organizations have issued specifications for foods. The arrangement of these cards can later be changed to conform with the classification scheme finally adopted by the Advisory Board.

24 New Standard Samples

Phosphate rock, sample No. 56, refined silicon No. 57, 75% ferro silicon No. 58, 50% ferro silicon No. 59, low carbon, ferro vanadium No. 60, high carbon ferro vanadium No. 61, and manganese bronze No. 62 are now being issued with provisional certificates.

PUBLICATIONS OF THE BUREAU OF STANDARDS RELEASED DURING JANUARY

Technologic Papers

T 240	Dynamometer tests of automobile tires. W. L. Holt and P. L. Wormeley	10¢
T 241	A comparison of the deoxidation effects of titanium and silicon on the properties of rail steel. George K. Burgess and G. Willard Quick	10¢
T 243	Stresses in a few welded and riveted tanks tested under hydrostatic pressure. A. H. Stang and T. W. Greene	10¢
T 244	A measure of the color characteristics of white papers. R. E. Lofton	5¢
T 245	Embrittlement of malleable cast iron resulting from heat treatment. Leslie H. Marshall	5¢

Scientific Papers

S 477	Spectroradiometric analysis of radio signals. Chester Snow	10¢

Circulars

C 56	Standards for electric service (second edition)	60¢
C 150	Recommended specification for quicklime and hydrated lime for use in the manufacture of sand-lime brick	5¢
C 153	Recommended specification for quicklime and hydrated lime for the manufacture of silica brick	5¢

Miscellaneous Publications

M 53	Annual report of the Director of the Bureau of Standards to the Secretary of Commerce for the fiscal year ended June 30, 1923	--

Simplified Practice

No. 9	Woven-wire fencing	5¢
No. 4	Asphalt	5¢

These publications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices given above.

Respectfully,

George K. Burgess, Director.

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